

Wolf River Basin Biotic Inventory and Analysis

A Baseline Inventory and Analysis of Natural Communities, Rare Plants and Animals, and other Selected Features.

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**Wisconsin's
Natural Heritage Inventory Program**

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INTRODUCTION

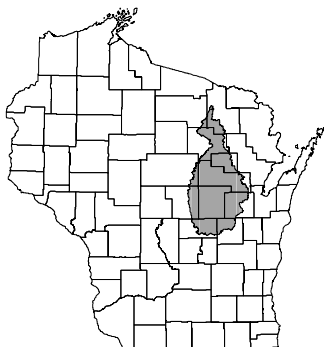


Figure 1. The Wolf River Basin

The Wisconsin Department of Natural Resources (WDNR), through the Natural Heritage Inventory (NHI) Section of the Bureau of Endangered Resources (BER) recently conducted an integrated land and water biotic inventory of the Wolf River Basin. This report represents the results of a three-year project.

The Wolf River Basin inventory effort was initiated in January of 1999 with the purpose of gathering data on natural communities, rare plants and animals, aquatic invertebrates, and other selected natural features for the entire basin. The information developed will be used to support various planning efforts to enhance the protection of the basin's ecologically significant natural resources. In particular, the inventory data will assist existing WDNR planning efforts, including the Lower Wolf River Bottomlands Natural Resources Area (NRA) and the Wolf River Basin plan. Additional planning efforts will benefit peripherally from this work, including

those of the Wolf River Partnership Team, Fish and Wildlife Integrated Planning, county and local government natural resources planning efforts, and private conservation planning. The biotic inventory information presented in this report is intended to be used alongside other information gathered for planning to develop a complete picture for the Basin.

BER has conducted biotic inventories for lands and waters throughout the State of Wisconsin, focusing on rare species, natural communities, and other elements of biodiversity. Most recently, BER completed detailed inventories for the Brule River and Northern Highland-American Legion State Forests and a broader inventory of the Lake Superior Basin wetlands. Three factors combined to create a challenging climate for the Wolf River Basin inventory: 1) the immense size of the basin, which includes approximately 3,670 square miles within portions of 11 counties and 8 ecological landscapes, 2) the large amount of private land ownership, an indicator of limited existing inventory information in state records, and 3) an immediate need to supply information for current planning projects in the Wolf River Basin. These factors represented a unique challenge and prompted BER to investigate alternative approaches for completing a comprehensive inventory of the entire Wolf River Basin.

BER developed a four-part approach for work conducted during the first field season. This work provided the necessary information required by the various planning projects above and set a solid foundation for which the remaining inventory efforts would be built upon. Although this plan represents a deviation from our typical inventory process (see Appendix A), it involved a number of pilot projects that, after future evaluation, may enhance the overall inventory process. The four inventory elements were as follows:

1. Analyze the existing data within the Wisconsin NHI Biological and Conservation Data (BCD) system on the status and presence of natural communities and rare plants and animals.
2. Conduct *coarse filter screening* (see Appendix A) on the Wolf River Basin to identify potential inventory areas for the ensuing inventory years.

3. Conduct an *Experts Workshop* for the Wolf River Basin to gather information on ecologically significant sites from individuals who have specialized and/or site-specific knowledge on the resources within the basin.
4. Conduct *fine filter inventory* (see Appendix A) on specific areas and selected taxa focusing on the southeastern portion of the Wolf River Basin to support the Lower Wolf River Bottomlands Natural Resources Area.

Fine filter inventory efforts were continued during 2000 and 2001 to include several additional taxa. Also, inventory efforts were broadened to include additional survey site locations throughout the basin.

This report summarizes work completed to date with an emphasis on:

1. analyzing results and providing ecological information for the Lower Wolf River Bottomlands NRA effort
2. summarizing inventory sites in the upper portion of the Wolf River Basin
3. suggesting potential NHI inventory needs for the future.

Organization of the Report

An interim report (WDNR 2000) was released in 2000, summarizing results from the 1999 inventory efforts to support master planning for the NRA. This report builds upon the interim report and summarizes overall findings of the inventory efforts to date. Part 1 contains general ecological information on the geology, hydrology, vegetation, and land use of the Wolf River Basin and methods used to conduct this project. Part 2 of the report summarizes inventory results for the Lower Wolf River Bottomlands Natural Resources Area (NRA). Part 3 briefly discusses inventory efforts implemented for the remainder of the basin, including the southern half of the Wolf River basin outside of the NRA and the northern half of the basin. Part 4 identifies key management issues and considerations related to the Natural Resources Area master planning effort. Part 5 identifies important conservation needs and priorities within the NRA. The appendices are meant to provide more detailed background materials and describe individual inventory efforts and results. The reports included in the appendices contain information on the objectives, methodologies, and results of each of the various inventory tasks. The majority of the detail relating to inventories will be found in these appendices. The appendices also contain additional detail about the majority of the Wolf River basin that was studied outside of the NRA.

PART 1: WOLF RIVER BASIN BIOTIC INVENTORY OVERVIEW

Description of Study Area

The Wolf Basin is 3671 sq. miles, or 6.6% of Wisconsin's land base. All of Waupaca county, and parts of Forest, Langlade, Marathon, Menominee, Oneida, Outagamie, Portage, Shawano, Waushara and Winnebago counties are located within the basin. The Wolf River originates in Pine Lake of southern Forest County and flows south, following the slope of the granite bedrock. It eventually drains into Lake Winnebago, after joining the Upper Fox River below Lake Poygan. The majority of the basin area extends westward from the Wolf River across Langlade, Shawano and Waupaca counties and the Menominee Reservation, with major tributaries flowing southeastward. These tributaries include the Red, Embarrass, Little Wolf and Waupaca Rivers. The Shioc River joins the Wolf from the East in central Outagamie County.

Geology

Many types of glacial landforms created by the Green Bay lobe of the Wisconsin Glaciation occur in the Wolf River Basin and influence the pattern of present land uses. Ground moraine and an extinct glacial lakebed extend across the southeast portion of the basin, creating a broad, level plain. Agriculture is the principal land use in this region. To the north and west, end and ground moraines surrounded by pitted outwash cover the majority of the landscape. Numerous small kettles containing lakes and peat bogs are embedded within these landforms. Due to the climate and the hilly morainal topography in the northern and western portions of the basin, forest cover is greater than in the southeast, and forestry gains in importance relative to agriculture.



Figure 2. Tension zone (adapted from Curtis 1959).

Vegetation

The northern and southern portions of the basin are roughly divided by the tension zone, a narrow region extending from northwest to southeast across Wisconsin, approximating an s-shape (Fig. 2). The tension zone separates the northern hardwood and prairie floristic provinces (Curtis 1959) and contains species associated with both provinces where many occur at the extent of their respective ranges. Highway 29 is used as a practical break between the north and south portions of the basin in this report, as it roughly coincides with the northern limit of the tension zone.

The pre-settlement vegetation of the basin was diverse and included floodplain forest, extensive wetland and swamp forest complexes, mesic (tallgrass) prairie, oak savanna, jack pine-scrub oak barren, maple-beech forest, red and white pine forest, and extensive hemlock hardwood/northern hardwood forest in the north. The plant communities throughout the basin formed a complex mosaic, resulting from complicated drainage patterns and landforms created by glacial deposits, edaphic factors, and recurrent natural disturbances such as windstorms, wildfires, floods, droughts, and insect infestations.

Only in the northern-most part of the basin (Forest and Langlade Counties, and to a lesser extent Menominee County) did a single community type prevail (sugar maple-hemlock-beech). The central and southern parts of the basin contained marshes, sedge meadows, swamp conifers (white cedar, black spruce and tamarack), lowland hardwoods (willow, soft maple, ash, elm and cottonwood), maple and beech forests, hemlock-hardwood forests, pine forests (white and red pine) and jack pine-scrub oak barrens. The pine-oak barrens were confined to small areas of sandy outwash located on the present day Menominee Reservation. The lowland hardwood, marsh and sedge communities present before settlement were largely concentrated along the Wolf River's lower-most reaches, below present-day Shawano south to Lake Poygan. The southwest corner of the basin (Waupaca, Portage and Waushara Counties) also included oak forest (red, white and black oak) and scattered areas of oak openings, oak barrens, and prairie (Finley 1976).

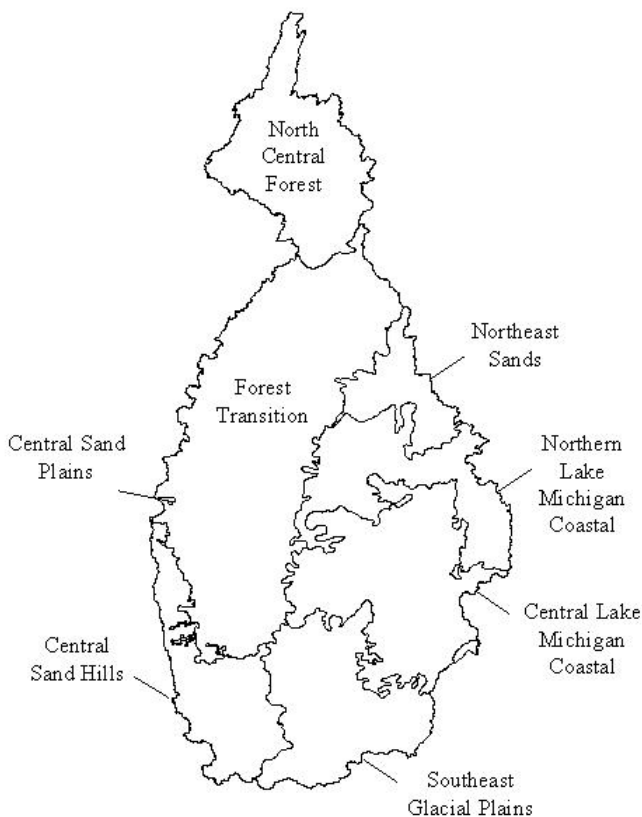


Figure 3: Ecological Landscapes of the Wolf River Basin

subdued topography results in somewhat fewer lakes and wetlands, and somewhat more homogenous forest coverage. This landscape comprises approximately 13% of the basin.

Forest Transition

The Forest Transition Ecological Landscape has the largest representation of any landscape within the Wolf River Basin. This landscape lies along the northern border of Wisconsin's Tension Zone, through the central and western part of the state, and supports both northern forests and agricultural areas. The eastern portion of the Ecological Landscape differs from the rest of the area in that it remains primarily

Ecological Landscapes

The Wisconsin DNR has mapped Wisconsin into areas of similar ecological potential and geography into units known as Ecological Landscapes. This classification is based on aggregations of subsections from the National Hierarchical Framework of Ecological Units (NHFEU) (Avers et al. 1994). The NHFEU and the Ecological Landscape systems delineate landscapes of similar ecological pattern and potential across the state in a way that is meaningful and useful to resource managers.

The Wolf River Basin is ecologically diverse on a landscape scale and is the point of convergence for half of the 16 Ecological Landscape types that occur in Wisconsin. Brief descriptions of the Ecological Landscapes that are represented within the Wolf River Basin are described below. Greatly expanded descriptions will be available shortly in the "Wisconsin Ecological Landscapes Handbook" (2002).

North Central Forest

The North Central forest landscape is characterized by gently rolling topography and silt loam soils. The forest cover is similar to the Northeast Hills, however the more

forested, and includes some extensive ecologically significant areas. Throughout this Ecological Landscape, small areas of conifer swamp are found near the headwaters of streams, and associated with lakes in kettle depressions on moraines. Ground flora show characteristics of both northern and southern Wisconsin, as this Ecological Landscape lies along the Tension Zone. This landscape comprises approximately 34% of the basin.

Northeast Sands

The Northeast Sands Ecological Landscape is still forested in many areas and contains several important river systems as well as extensive wetlands. Historically, extensive oak/jack pine barrens and jack pine forests were found in the outwash sand portions of this Ecological Landscape. Moraines supported forests of hardwoods, red pine and white pine. Outwash plains often contained pitted depressions, resulting in numerous wetlands and kettle lakes. Current forest vegetation is predominantly aspen, followed by northern hardwoods. Jack pine remains on the outwash plains along with northern pin oak. There are several important occurrences of jack pine/oak barren communities. A small percentage of this Ecological Landscape contains spruce-fir-cedar forest and lowland hardwood forest. The largest river is the Menominee, located on the Michigan-Wisconsin border. Several additional wild rivers within this Ecological Landscape are the Wolf, Pine, Popple, and Pike. This landscape comprises only 5% of the basin.

Northern Lake Michigan Coastal

The Northern Lake Michigan Coastal landscape is quite diverse, extending from the west shore of Lake Michigan to its westernmost extent within the Wolf River Basin. Historic vegetation included maple-basswood-beech forest, hemlock-hardwood forest, northern white-cedar swamp, hardwood-conifer swamp, and wet meadows. The major forest type is maple-basswood, with smaller amounts of lowland hardwoods, aspen-birch, lowland conifer, white-red-jack pine, and oak-hickory. This landscape comprises approximately 10% of the basin.

Central Sand Plains

The Central Sand Plains landscape makes up less than 1% of the Wolf River Basin, so it will not be discussed here.

Central Lake Michigan Coastal

The Central Lake Michigan Coastal landscape stretches from southwestern Door County, west across Green Bay to the Wolf River drainage and central Waupaca County, then southeast to Manitowoc County, and southward in a narrow strip along Lake Michigan to central Milwaukee County. The terrain is rolling where the surface is underlain by ground moraine, variable over areas of outwash, and nearly level where lacustrine deposits are significant. Historically, hardwood forests of sugar maple, basswood, beech, white ash, and red oak covered most of this landscape. White pine was locally important. Areas of poorly drained glacial lakeplain supported extensive wet forests of tamarack, white cedar, black ash, red maple, and elm, while the Wolf and Embarrass Rivers flowed through extensive floodplain forests of silver maple, green ash, and swamp white oak. Today approximately 84% of this Ecological Landscape is non-forested. The remaining forest consists mainly of mesic maple-basswood or maple-beech types or lowland hardwoods such as soft maples and ashes. Fragmentation of upland habitats is now severe throughout this landscape, and invasive plants have become a major concern, especially reed canary grass, giant reed, purple loosestrife, garlic mustard, common buckthorn, and honeysuckles. The waters of the Wolf-Embarrass River corridors provide seasonally critical habitat for numerous animals. Invasive species are a problem in many of the aquatic systems in this landscape. This landscape comprises approximately 17% of the basin.

Central Sand Hills

This area of end and recessional moraines includes rolling topography with sandy soils and is dominated by dairy (and small farm) agriculture interspersed with oak/pine forests. Historically, oak and pine barrens, sand prairies, and xeric pine-oak forests were widespread. Oak barrens and dry sand prairie remnants with management/restoration potential are still present. The concentration of cold headwater streams emanating from the moraines is significant. Remnant patches of natural vegetation are frequent, but the vegetation pattern is highly fragmented with few large patches intact. This landscape comprises approximately 9% of the basin.

Southeast Glacial Plains

These level to gently rolling plains in the SE portion of the basin are dominated by farmland interspersed with extensive wetland complexes and small hardwood forest/patches. Most of the area is underlain by rich silt loam or organic soils from glacio-lacustrine deposits and supports communities with high nutrient affinities. Wetlands include marshes, sedge meadows, prairies, hardwood swamps and limited tamarack/conifer swamps. Upland forests are primarily maple/beech/basswood cover types. This landscape comprises approximately 13% of the basin.

Importance of the Wolf River to Ecoregional Planning

The Nature Conservancy (TNC) is currently developing ecoregional plans for each of the major ecoregions in the United States. In Wisconsin, TNC has nearly completed the plan for the Great Lakes Ecoregion (TNC 2000) which includes the Wolf River Basin. TNC's ecoregional planning designs a portfolio of sites that collectively conserve viable natural community types, globally rare native species, and other selected features. Within each site, TNC anticipates working with their partners to conserve, or where necessary restore, the ecosystem patterns and processes that sustain the elements for which that site was selected (TNC 1997).

Map 1 shows the preliminary aquatic portfolio sites that were identified within the Wolf River Basin. Portions of the Wolf River main stem, the lower Embarrass River, and the Crystal/Waupaca River fall within the master plan inventory area. These sites have been identified because of their ecoregional significance and, as priorities, are in need of conservation activities to ensure protection of the diversity of the aquatic species found here.

Methods

Coarse Filter Screening

Recognizing that the large size of the Wolf River Basin presented a difficult challenge for detailed field studies, BER used various methods of compiling information on ecologically significant lands that was scientifically accurate and resource efficient. By combining knowledge of WISCLAND landcover data and aerial photo interpretation, BER intended to identify potentially important sites. In addition, BER hoped to develop a Coarse Filter Screening process that could be easily adapted for use in other large geographic areas throughout the state of Wisconsin.

Clark Forestry, Inc. was contracted by BER to conduct the coarse filter screening in 1999. The purpose of the screening was to identify sites with high potential for occurrences of threatened, endangered and special concern species, significant natural communities, or sites of otherwise high conservation value. The primary emphasis was on the identification of potential, high quality natural communities. A related goal was to create a cost-effective, and easily replicated process to identify sites using GIS, aerial

photography, and existing information sources, and compare the results of such a process to the recommendations obtained from basin experts. Further details of the coarse screening process can be found in Appendix K.

Budget and time constraints did not allow for ground truthing or fieldwork throughout the basin to support the coarse filter process in 1999. It was assumed that the methods used in this process would result in missing many small areas and areas whose attributes could not be captured using existing information sources (see results and recommendations in Appendix K).

Wolf River Basin Experts Workshop

In an effort to meet the immediate needs for inventory information, BER began to search for an inventory approach that would be more time and cost efficient. Recognizing the wealth of information that is available from local experts in the region, BER set out to develop a workshop process that would gather information from individuals with specialized knowledge of the resources in the area. Working with the assistance of a Design Team of Regional DNR staff, BER designed a workshop approach that would take advantage of information from this valuable source:

- ◆ Inventory information compiled from many different individuals (called *experts*) who have first-hand knowledge of ecologically significant sites “on-the-ground” (called *Expert Sites*). Table L-1 in Appendix L includes a full list of the Expert Sites and other relevant site information.

NHI believed that the Experts would provide insight into the effectiveness of the coarse filter work and provide additional fine scale information not obtainable from the general coarse-filter screening. Coarse filter screening and expert sites are illustrated on Map 2. At the workshop, participants worked together to compare the information from the two different inventory approaches and discuss priorities for future field inventory and resource conservation. The collaborative effort represented by this approach took advantage of many sources of expert information and supported long-term awareness of the basin and its conservation needs and set a precedent for what BER hopes will be more pro-active approaches to basin-wide inventory in the future. Details of the purposes and results of the experts workshop can be found in Appendix L.

Map 3 illustrates the final result of the Workshop: Sites with High Potential for Conservation and Inventory. Thirty-nine sites were identified from the list of Coarse Filter and Expert sites that represent the prioritization of sites by Experts based on their personal knowledge and information on hand at the Workshop. This information was used to support basin planning and to identify inventory needs for the 2000 field season.

The sites of high potential are distributed among most of the eight ecological landscapes represented within the basin. There are 10 high potential sites (based on the location of their center point) in the North Central Forest, 10 in the Forest Transition, 1 in the Northern Lake Michigan Coastal, 7 in the Central Lake Michigan Coastal, 5 in the Central Sand Hills, and 6 in the Southeast Glacial Plains. There are no high potential sites located in the Central Sand Plains or the Northeast Sands landscapes. Some sites span more than one landscape.

Fine Filter Inventory Methods

Appendix A contains provides an overview of the NHI program and describes methodology used. All fieldwork was conducted between May of 1999 and September 2001. Fieldwork was designed to target the following: natural communities, aquatic invertebrates, terrestrial invertebrates, small mammals, fishes, birds, and herptiles. In addition, rare plant records were added during the course of the natural community inventory work. Map 4 depicts the inventory locations for each of the surveys. The inventory

methods utilized, as well as results, for each of the above groups are included here as separate appendices (Table 1).

Table 1: Field survey types, primary authors, and location of survey information within this report.

Taxa / Inventory Type	Contributing Author(s)	Appendix (Appendices)
Aquatic Invertebrates	Kurt Schmude	C, E.1, E.2
Priority Stream Segment Descriptions	Compilation of all inventory efforts with emphasis on aquatic systems; Bill Smith, John Lyons	C
Birds	Todd Miller, Dennis Kuecherer, Eric Epstein	I
Fishes	John Lyons	C,J
Herptiles	Erik R. Wild	C,H
Natural Communities	Elizabeth Spencer, Eric Epstein, and Andy Clark, Emmet Judziewicz	N.1, N.2
Plants	Craig Anderson, Eric Epstein, Bill Smith, and Andy Clark	O
Small Mammals	Richard Bautz	F.1, F.2
Terrestrial Invertebrates	Kathy Kirk and Matt Brust	G
Priority Site Descriptions	Compilation of all inventory efforts with emphasis on natural communities and rare taxa; Eric Epstein, Andy Clark, Bill Smith, Craig Anderson, Elizabeth Spencer	B
Upper Wolf River Basin	Compilation of all inventory efforts with emphasis on primary inventory sites (natural communities); Eric Epstein and Elizabeth Spencer	D

Inventory locations within the NRA were surveyed at the highest intensity and for each of the taxa groups listed above. Several ecologically important priority sites and stream segments were identified within the NRA based on inventory results to support WDNR master planning (see Part 2 of this report regarding inventory within the NRA and Appendices B and C that describe priority sites and stream segments, respectively within the NRA). Additional sampling was performed at numerous locations outside of the basin, as resources allowed. Part 3 of this report gives a brief description of the areas outside of the NRA, and Appendix D describes primary inventory sites sampled within the northern portion of the Wolf River Basin.

A significant portion of the upper basin (Menominee County) was not surveyed as part of this project due to logistical considerations. Menominee County has Federal Reservation status, is a sovereign nation, and is rich in natural communities typical of a forested landscape. These considerations provide unique challenges and opportunities for a state government-coordinated resource inventory project, and because of the master planning needs of the Lower Wolf Bottomlands Natural Resource Area, it was thought best to focus our limited basin inventory efforts in the lower Basin. There is great interest in working with the Menominee in the near future on a comprehensive biotic inventory project on Tribal lands.

Future Inventory Needs

Additional comprehensive inventory work has not been scheduled specifically for the Wolf River Basin at this time. However, due to the vastness and ecological importance of the basin, there are several areas that could benefit from additional inventory efforts. The priorities for future inventory work include the following:

1. More thoroughly examine sites identified as having high potential for conservation and inventory
2. Complete comprehensive survey work in the northern half of the Wolf River Basin
3. More thoroughly examine the southwestern portion of the basin, focusing on natural communities such as prairies, savannas, dry forests, and seepage lakes, plus birds, herptiles, and rare plants.
4. Conduct additional inventory to fill data gaps and provide more detailed information on selected taxa within the NRA. Examples could include marsh birds such as rails and bitterns, forest interior birds, and certain herptiles.

PART 2: LOWER WOLF RIVER BOTTOMLANDS NATURAL RESOURCES AREA SUMMARY

Introduction

In 1999, the WDNR initiated master planning for various state-owned properties located along the Wolf River from the Shawano Dam in Shawano County downstream to Lake Poygan in Winnebago County. Recently (March 2002) a Feasibility Study (WDNR 2002) was approved, officially establishing the Lower Wolf River Bottomlands Natural Resources Area (NRA). The NRA is about 335 square miles and includes parts of Waupaca, Outagamie, Shawano, and Winnebago counties.

Map 5 depicts the NRA and the many existing state wildlife areas, fisheries areas, and state natural areas (see inset) that are set within a larger context of private lands. The area includes a wealth of wildlife and natural resources that are influenced by diverse interests. Property master planning involves the public in a process that will determine the use and management of state lands according to the many interests, needs, and opportunities that exist.

Lower Wolf River Bottomlands Master Plan Properties:	
1.	Deer Creek SWA
2.	DeWolfe SWA
3.	Hortonville Bog SNA
4.	Wolf River Bottoms SWA -LaSage Unit
5.	Mack SWA
6.	Maine SWA
7.	Mukwa SWA
8.	Navarino SWA
9.	Outagamie SWA
10.	Rat River SWA
11.	Shaky Lake SNA
12.	Wolf River Bottoms SWA – K & S Unit
13.	Wolf River SFA
14.	Wolf River SWA
15.	Wolf River Fisheries Remnants

Geology and Vegetation

The Lower Wolf River Bottomlands NRA is contained entirely within the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscapes. See Part 1 for a description of these landscapes, as well as others occurring within the basin.

Summary of NHI Data from the Endangered Resources Program for the NRA

Following is information on the significant natural communities, rare plants, animals, and other significant ecological features that are known to exist within the NRA. This information is from the NHI's Biological and Conservation Data (BCD) system. The most recent information added to the BCD is from the 2001 field season. Map 6 depicts the location of element occurrences (EOs) within the Wolf River Basin, and highlights those EO's documented from 1999-2001 (including, but not limited to, those identified as a result of 1999-2001 fieldwork). Appendices N.1, N.2, O, and P provide a full listing of all the known elements that occur within the entire basin and include descriptions and management considerations for each.

Inventory Sites

During the 1999 field season, surveys of natural communities were confined to the southeastern portion of the basin. Fieldwork in 2000 and 2001 expanded the scope of this effort, geographically, and included lands in other ownerships for which the DNR has secured permission to conduct surveys.

Surveys documented 64 stands of natural communities at 24 major sites. Fourteen of these sites are state-owned, with Wildlife Management, Fish Management, and Endangered Resources the primary programs involved. The remaining ten properties are privately-owned.

BER Priority Inventory Sites located within the NRA are listed below. Sites are numbered from north to south as they occur within the NRA. Site descriptions and a map containing all surveyed sites (Map 10) are included in Appendix B.

- | | |
|--|--|
| 1. Navarino State Wildlife Area | 14. Mosquito Hill / Liberty Bottoms |
| 2. Leeman Bottoms | 15. Wolf River State Fishery Area |
| 3. Deer Creek State Wildlife Area | 16. Mukwa Bottoms |
| 4. Embarrass River - CTH XX to CTH F | 17. Wolf River Corridor -Shaw's Landing to Fremont |
| 5. Maine State Wildlife Area | 18. Shaky Lake |
| 6. Maine Bottoms | 19. Rat River |
| 7. Wolf River Wetlands | 20. Lower Wolf River Marshes |
| 8. Outagamie Bottoms | 21. Winchester Meadows |
| 9. Mack State Wildlife Area | 22. Piacenza Marsh |
| 10. Lower Embarrass River Bottoms | 23. Clark's Point |
| 11. Hortonville Bog State Natural Area | 24. Poygan Islands |
| 12. LaSage Bottoms | |
| 13. S&M Bottoms | |

In addition to the 24 Priority Sites shown above, BER identified four ecologically important stream segments within the NRA. These were selected based on analysis of inventory data, especially mussel, macroinvertebrate, and stream surveys. Homogeneous stream segments harboring large numbers of taxa, rare taxa, and/or regionally significant populations were identified as Priority Stream Segments.

Priority Stream Segments located within the NRA are listed below. Site descriptions and a map containing all surveyed sites (Map 11) are included in Appendix C.

1. Wolf River Corridor – Shawano to CTH CCC
2. Wolf River Corridor – CTH CCC to Lake Poygan
3. Lower Embarrass River Corridor
4. Little Wolf River Corridor

Natural Communities

Brief descriptions of all natural communities surveyed within the NRA to date can be found in Appendix N.1. The following is a list of those natural community types known to occur within the NRA that have local or regional significance.

Natural community types of especially high significance because of their extent, quality or condition within the master plan area include:

- **Emergent Aquatic** (cattail-bulrush-bur-reed-arrowhead)
- **Emergent Aquatic** (wild rice)
- **Submergent Aquatic** (pondweeds-wild celery-waterweed-water-milfoil)
- **Southern Sedge Meadow** (tussock sedge-Canada bluejoint grass)
- **Floodplain Forest** (silver maple-green ash-swamp white oak)
- **Southern Hardwood Swamp** (red maple-elms-ashes)

Natural community types which are not extensive within the NRA but are significant because of their rarity statewide, their quality and condition, and/or because they provide habitat for locally or regionally rare species include:

- **Southern Mesic Forest** (maple-basswood or maple-beech forests on terraces just above the Wolf River floodplain).
- **Northern Dry-mesic Forest** (white pine-red oak-red maple)
- **Northern Wet-mesic Forest** (white cedar)
- **Northern Mesic Forest** (sugar maple – hemlock – beech – basswood)
- **Northern Sedge Meadow** (*Carex* spp.-Canada bluejoint grass)
- **Tamarack Swamp** (tamarack-Labrador tea-sedges-mosses)
- **Open Bog** (sphagnum mosses-leatherleaf)
- **Muskeg** (sphagnum mosses-ericaceous shrubs-black spruce-tamarack)
- **Wet Prairie** (prairie cordgrass-Canada bluejoint grass)
- **Wet-mesic Prairie** (big bluestem-prairie dock)
- **Sand Prairie** (little bluestem-junegrass)

Other habitats that were occasionally surveyed within the NRA that either represent cover types not included under the concept of natural communities by NHI at this time or are highly altered or degraded. Any of these types can sometimes provide important habitat for sensitive species or perform important functions such as buffering or increasing effective habitat area.

- **Restored Prairie**
- **Reed canary grass meadow**
- **Aspen forest**
- **Pine plantation**
- **Old field**

Aquatic Habitats

As used here aquatic habitats are somewhat homogeneous segments of streams or lakes that are similar in physical characteristics such as landform geology, surficial geology, local physiology, size, shape, and network position. These “macrohabitat” types are thought to correspond to a coarse level of biological community organization or sometimes to actual species assemblages. Aquatic macrohabitats may be further split out into habitat units based on water depth, light penetration, velocity, and substrate. These

units are thought to correspond to actual species assemblages (most often animals) or indicator taxa. This physically based hierarchical classification framework is in contrast to that used in the Priority Sites section in this report (Appendix B) which are typically defined by repeating plant assemblages. See [A Classification Framework for Freshwater Communities](#), published by The Nature Conservancy (TNC 1997), for more details of this approach. The current NHI aquatic classification system has some similarities to the TNC system described above in that it is physically based, but it recognizes fewer variables and tends to classify an entire stream or lake as one type. NHI will be integrating the current system with TNC's system in the near future. Towards this revision of the NHI aquatic classification system a GIS based database has been developed which describes the physical stream resources at the macrohabitat level for the entire state. Maps 7-9, in addition to the summaries presented below at the macrohabitat level for the lower Wolf River Basin, are derived from this database. A similar lake classification system will likely be developed in the next few years.

Explanation of Maps 7, 8, and 9. Three stream variables are represented for each homogeneous segment, i.e. (1) hydrologic source (Map 7) (2) stream size (Map 8), and (3) gradient (Map 9). Each of these variables is a continuum, and they have been arbitrarily divided into three to five classes.

- *Hydrologic source* (Map 7) could be represented as any one of five classes describing dominant water source including (1) artificial/unknown, (2) high runoff, (3) high runoff/low groundwater, (4) low runoff/high groundwater, and (5) high groundwater.
- *Stream size* (Map 8) is determined by the number of first order (headwater) streams upstream with the classes being 1, 2-10, 11-50, 51-200, and 200+. On this map, size is represented by the width of the line.
- *Gradient* (Map 9) (change in elevation divided by segment length) is represented by three groups, slope of 0-.002 (slow flat water), slope of .002-.019 (medium flow rate), and slope greater than .002 (high flow rate). The number of classes actually represented in a particular area like the Lower Wolf River Basin will generally be fewer than those for the entire state.

Rare Plants

The Wisconsin Natural Heritage Inventory lists 11 rare plant species in the Lower Wolf River Bottomlands NRA (Table 2). These include 2 State Threatened species, and 7 State Special Concern species. No federally listed plant species have been found in the NRA.

Table 2. Rare Plants of the Lower Wolf River Bottomlands Master Plan Inventory Area

Scientific Name	Common Name	Observation Date	WI State Status	Federal Status
<i>Arabis missouriensis</i> var <i>deamii</i>	Deam's rockcress	1959	SC	
<i>Cardamine pratensis</i>	Cuckooflower	2001	SC	
<i>Carex formosa</i>	Handsome sedge	2001	THR	
<i>Carex gynocrates</i>	Northern bog sedge	2000	SC	
<i>Cypripedium reginae</i>	Showy lady's-slipper	2000	SC	
<i>Medeola virginiana</i>	Indian cucumber-root	2001	SC	
<i>Phegopteris hexagonoptera</i>	Broad beech fern	2001	SC	
<i>Platanthera dilatata</i>	Leafy white orchis	1931	SC	
<i>Platanthera orbiculata</i>	Large roundleaf orchid	1931	SC	
<i>Triglochin maritima</i>	Common bog arrow-grass	2001	SC	
<i>Valeriana sitchensis</i> ssp <i>uliginosa</i>	Marsh valerian	1944	THR	

WI Status: Protection category designated by the Wisconsin DNR. END = endangered; THR = threatened; SC = Special Concern. **Federal Status:** Federal protection status designated by the Office of Endangered Species, U.S. Fish and Wildlife Service indicating the biological status of a species in the United States. LE = listed endangered; LT = listed threatened. The complete NHI listed is provided in Appendix Q.

Half of the rare plants in the Lower Wolf River Bottomlands NRA are associated with wetland communities. Four species grow in some type of calcareous wetlands. The remaining species grow in hardwood, conifer-hardwood, or conifer forests.

Of the 21 rare plant populations documented in the Lower Wolf River Bottomlands NRA, 9 grow in State Wildlife Areas and 3 grow on State Natural Areas. Those state-managed populations account for 4 of the 11 rare plant species known from the area. Any future survey work may reveal a larger proportion of these species on state-managed lands.

Botanical surveys in the Lower Wolf River Bottomlands NRA updated or revealed 17 populations of 7 species. Despite repeated surveys in the 1980's, no one had documented handsome sedge (*Carex formosa*), a Threatened species in Wisconsin, growing in the Wolf River Basin since the 1940s. In 1999, Andy Clark found a population on Wolf River Bottoms SWA - LaSage Unit and another just outside Mukwa State Wildlife Area. Additional records were added for this species in 2000 and 2001.

The occurrences for three species in the NRA, Deam's rockcress, leafy white orchis, and marsh valerian, are known only from historical records. The location information associated with these records is imprecise, and these occurrences might have actually been in the NRA. Further inventory in or near the NRA could locate new occurrences for these species. Leafy white orchis and marsh valerian have been found more recently elsewhere in the Wolf River Basin outside of the NRA. Deam's rockcress hasn't been documented in the Basin since 1965.

A discussion of all known rare vascular plants within the Wolf River Basin is provided in Appendix O.

Rare Animals

The Wisconsin Natural Heritage Inventory lists 115 rare animals in the Lower Wolf River Bottomlands Master Plan inventory area (Table 3). These include 4 WI Endangered species, 18 WI Threatened species, and 93 Special Concern species. Twelve animal species are considered rare or local throughout their range (G3). The remaining rare species are considered secure (G4-G5) or their global status is unknown. From the perspective of the state of Wisconsin, 12 species from the basin are critically imperiled (S1), 46 species are imperiled (S2), and 50 species are rare or uncommon (S3). The remaining 7 species are either secure (S4), of unknown status (SU) or extirpated (SX).

Aquatic habitats are even more important in the southeastern portion of the basin than in the basin as a whole and are considered critical for 62 percent of the rare species found in the Master Plan inventory area. Other important habitats for rare species in the basin are wetlands, harboring 14 percent of the taxa, pine/oak barrens with 10 percent, southern forests with 10 percent, northern forests with 7 percent, grasslands with 4 percent and oak savanna with one percent.

Significant occurrences of aquatic animals in the NRA are further described in Appendix P. Terrestrial animals of particular importance are the concentrations of Red-shouldered Hawk (threatened), Cerulean Warbler (threatened), Prothonary Warbler (special concern), and a number of more common floodplain forest birds. Regionally significant habitats for these species occur here, especially in larger connected patches of mature forest. In addition, wetland birds, including nesting colonies of Common and Forster's Tern (both endangered), as well as several special concern species including Black Tern, Least Bittern, American Bittern, Common Moorhen, and Northern Harrier are concentrated within the lowermost portion of the NRA. In addition, King Rail and Yellow Rail (both state threatened) were found here recently. Blanding's turtles (threatened) use the NRA in good numbers. Sandy openings in the Navarino State Wildlife Area support a number of rare insects not found elsewhere in the NRA. The few bogs in the NRA harbor a number of rare wetland insects including beetles and lepidoptera species. Old field

habitats adjoining some of the larger marshes and meadows support many grassland birds, including special concern species such as Upland Sandpiper, Dickcissel, and Grasshopper Sparrow.

Table 3. Rare Animals of the Lower Wolf River Bottomlands Master Plan Inventory Area

Scientific Name	Common Name	Observation Date	WI State Status	Federal Status
<i>Acipenser fulvescens</i>	Lake sturgeon	2001	SC/H	
<i>Acris crepitans blanchardi</i>	Blanchard's cricket frog	1991	END	
<i>Agabates acuductus</i>	A hydrophylid beetle	2000	SC/N	
<i>Agabus bicolor</i>	A predaceous diving beetle	1999	SC/N	
<i>Agabus inscriptus</i>	A predaceous diving beetle	1999	SC/N	
<i>Agabus wasastjernae</i>	Predaceous diving beetle	2000	SC/N	
<i>Alasmidonta marginata</i>	Elktoe	1995	SC/H	
<i>Alasmidonta viridis</i>	Slippershell mussel	1991	THR	
<i>Ammodramus henslowii</i>	Henslow's sparrow	2000	THR	
<i>Ardea herodias</i>	Great blue heron	2000	SC/M	
<i>Baetisca obesa</i>	A mayfly	1999	SC/N	
<i>Botaurus lentiginosus</i>	American bittern	2001	SC/M	
<i>Brachycercus prudens</i>	A caenid mayfly	1999	SC/N	
<i>Buteo lineatus</i>	Red-shouldered hawk	2000	THR	
<i>Celina hubbelli</i>	A predaceous diving beetle	1999	SC/N	
<i>Chlidonias niger</i>	Black tern	2001	SC/M	
<i>Chlosyne gorgone</i>	Gorgone checker spot	1991	SC/N	
<i>Cicindela lepida</i>	Little white tiger beetle	2000	SC/N	
<i>Cicindela patruela huberi</i>	A tiger beetle	2000	SC/N	
<i>Cicindela patruela patruela</i>	A tiger beetle	2000	SC/N	
<i>Clemmys insculpta</i>	Wood turtle	2000	THR	
<i>Coccyzus americanus</i>	Yellow-billed cuckoo	1984	SC/M	
<i>Copelatus glyphicus</i>	Predaceous diving beetle	2000	SC/N	
<i>Cymbiodyta acuminata</i>	A water scavenger beetle	1999	SC/N	
<i>Cymbiodyta minima</i>	A water scavenging beetle	1999	SC/N	
<i>Dendroica cerulea</i>	Cerulean warbler	2000	THR	
<i>Dubiraphia bivittata</i>	A dubiraphia riffle beetle	2000	SC/N	
<i>Empidonax virescens</i>	Acadian flycatcher	2000	THR	
<i>Emydoidea blandingii</i>	Blanding's turtle	2001	THR	
<i>Enochrus consortus</i>	A water scavenging beetle	2000	SC/N	
<i>Enochrus perplexus</i>	A water scavenger beetle	2000	SC/N	
<i>Enochrus sayi</i>	A water scavenging beetle	1999	SC/N	
<i>Epioblasma triquetra</i>	Snuffbox	1995	END	
<i>Erimyzon sucetta</i>	Lake chubsucker	1981	SC/N	
<i>Erynnis lucilius</i>	Columbine dusky wing	1991	SC/N	
<i>Etheostoma clarum</i>	Western sand darter	2001	SC/N	
<i>Euphyes bimacula</i>	Two-spotted skipper	1989	SC/N	
<i>Euphyes dion</i>	Dion skipper	2000	SC/N	
<i>Fundulus diaphanus</i>	Banded killifish	1974	SC/N	
<i>Gallinula chloropus</i>	Common moorhen	2001	SC/M	
<i>Gomphurus externus</i>	Plains clubtail	1999	SC/N	
<i>Gomphurus ventricosus</i>	Skillet clubtail	1999	SC/N	
<i>Gomphus viridifrons</i>	Green-faced clubtail	1999	SC/N	
<i>Graphoderus manitobensis</i>	A predaceous diving beetle	1999	SC/N	
<i>Haliaeetus leucocephalus</i>	Bald eagle	1989	SC/FL	LT,PD
<i>Haliplus canadensis</i>	A crawling water beetle	1999	SC/N	
<i>Haliplus pantherinus</i>	A crawling water beetle	1999	SC/N	
<i>Hebrus buenoi</i>	A velvet waterbug	2000	SC/N	
<i>Hebrus burmeisteri</i>	A velvet waterbug	1999	SC/N	
<i>Helocombus bifidus</i>	A water scavenging beetle	1999	SC/N	
<i>Hesperia leonardus leonardus</i>	Leonard's skipper	2000	SC/N	
<i>Hesperocorixa semilucida</i>	A water boatman	2000	SC/N	
<i>Hetaerina titia</i>	Dark rubyspot	1999	SC/N	
<i>Hydrochara leechi</i>	A water scavenger beetle	1999	SC/N	
<i>Hydrochara spangleri</i>	A water scavenger beetle	2000	SC/N	

Scientific Name	Common Name	Observation Date	WI State Status	Federal Status
<i>Hydrometra martini</i>	A water measurer	2000	SC/N	
<i>Hydroporus badiellus</i>	A predaceous diving beetle	1999	SC/N	
<i>Hydropsyche bidens</i>	A caddisfly	1999	SC/N	
<i>Ilybius discedens</i>	A predaceous diving beetle	1999	SC/N	
<i>Ilybius ignarus</i>	Diving beetle	2000	SC/N	
<i>Ilybius incarinatus</i>	A predaceous diving beetle	2000	SC/N	
<i>Isoperla bilineata</i>	A perlid stonefly	1999	SC/N	
<i>Isoperla marlynia</i>	A perlid stonefly	1999	SC/N	
<i>Ixobrychus exilis</i>	Least bittern	2000	SC/M	
<i>Laccobius agilis</i>	A water scavenging beetle	1999	SC/N	
<i>Lepomis megalotis</i>	Longear sunfish	1926	THR	
<i>Lestes inaequalis</i>	Elegant spreadwing	2000	SC/N	
<i>Liodessus cantralli</i>	Cantrall's bog beetle	1999	SC/N	
<i>Liodessus flavicollis</i>	A predaceous diving beetle	2000	SC/N	
<i>Lioporeus triangularis</i>	A predaceous diving beetle	1999	SC/N	
<i>Luxilus chrysocephalus</i>	Striped shiner	UNK	END	
<i>Lythrurus umbratilis</i>	Redfin shiner	1926	THR	
<i>Macrhybopsis aestivalis</i>	Shoal chub	2000	THR	
<i>Matus bicarinatus</i>	A predaceous diving beetle	2000	SC/N	
<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker	1984	SC/M	
<i>Meropleon ambifuscum</i>	Newman's brocade	1994	SC/N	
<i>Moxostoma carinatum</i>	River redhorse	2000	THR	
<i>Moxostoma valenciennesi</i>	Greater redhorse	2000	THR	
<i>Neoscutopterus hornii</i>	A predaceous diving beetle	1999	SC/N	
<i>Nepa apiculata</i>	A water scorpion	2000	SC/N	
<i>Neurocordulia yamaskanensis</i>	Stygian shadowfly	1999	SC/N	
<i>Notropis anogenus</i>	Pugnose shiner	1963	THR	
<i>Notropis texanus</i>	Weed shiner	2001	SC/N	
<i>Nyctanassa violacea</i>	Yellow-crowned night-heron	1984	THR	
<i>Nycticorax nycticorax</i>	Black-crowned night-heron	2001	SC/M	
<i>Ophiogomphus howei</i>	Pygmy snaketail	1999	THR	
<i>Opsopoeodus emiliae</i>	Pugnose minnow	2000	SC/N	
<i>Palaemonetes kadiakensis</i>	Mississippi grass shrimp	2001	SC/N	
<i>Pandion haliaetus</i>	Osprey	2001	THR	
<i>Paracloeodes minutus</i>	A small minnow mayfly	1992	SC/N	
<i>Parameletus chelifer</i>	A primitive minnow mayfly	1993	SC/N	
<i>Pelocoris femorata</i>	A creeping water bug	1999	SC/N	
<i>Pentagenia vittigera</i>	An ephemerid mayfly	1992	SC/N	
<i>Plauditus cestus</i>	A small minnow mayfly	1999	SC/N	
<i>Pleurobema sintoxia</i>	Round pigtoe	1995	SC/H	
<i>Poanes massasoit</i>	Mulberry wing	2000	SC/N	
<i>Poanes viator</i>	Broad-winged skipper	2000	SC/N	
<i>Procambarus acutus</i>	White river crawfish	2000	SC/N	
<i>Protonotaria citrea</i>	Prothonotary warbler	2000	SC/M	
<i>Pseudiron centralis</i>	A heptageniid mayfly	1999	SC/N	
<i>Rallus elegans</i>	King rail	2000	SC/M	
<i>Ranatra nigra</i>	A water scorpion	2000	SC/N	
<i>Rhantus sinuatus</i>	A predaceous diving beetle	2000	SC/N	
<i>Simpsonaias ambigua</i>	Salamander mussel	1991	THR	
<i>Sorex arcticus</i>	Arctic shrew	1999	SC/N	
<i>Sperchopsis tessellatus</i>	A water scavenging beetle	1999	SC/N	
<i>Spharagemon marmorata</i>	Northern marbled locust	1999	SC/N	
<i>Stenelmis antennalis</i>	A riffle beetle	1999	SC/N	
<i>Stenelmis bicarinata</i>	A riffle beetle	1999	SC/N	
<i>Stenelmis fuscata</i>	A riffle beetle	1999	SC/N	
<i>Sterna forsteri</i>	Forster's tern	2000	END	
<i>Stylurus notatus</i>	Elusive clubtail	2000	SC/N	
<i>Trachyrhachys kiowa</i>	Ash-brown grasshopper	1999	SC/N	
<i>Triaenodes nox</i>	A caddisfly	2000	SC/N	
<i>Tritogonia verrucosa</i>	Buckhorn	1995	THR	

WI Status: Protection category designated by the Wisconsin DNR. END = endangered; THR = threatened; SC = Special Concern. **Federal Status:** Federal protection status designated by the Office of Endangered Species, U.S. Fish and Wildlife Service indicating the biological status of a species in the United States. LE = listed endangered; LT = listed threatened; LEPT = listed endangered in part of its range, threatened in another part; PE = proposed endangered; PT = proposed threatened; PEPT = proposed endangered in part of its range threatened in another. **Group Name:** ^ = aquatic species. (See Appendix Q for the complete NHI Working list)

As with the entire basin, inventory coverage in the Lower Wolf River Bottomlands Master Plan inventory area has been uneven in terms of species or species groups surveyed, chronology, and geography. The Lower Wolf River and several major tributaries have been systematically sampled for mussels, fish and aquatic insects, but few other groups of animals have such systematic coverage. A number of invertebrates (mostly aquatic insects) were added to the NHI working list as a result of inventory work conducted during the 1999-2001 field seasons, as well as subsequent literature review.

A discussion of all known rare animals within the Wolf River Basin is provided in Appendix P.